Pin-wells and rag-bushes are still frequented, and on the night before emigrating people will sleep in the open, beside one of the holy wells, in order that they may have good fortune in the country to which they are going. There is a firm belief in the power of the Evil Eye, and on certain days that are considered unlucky, even burials are avoided.

The antiquities of the Aran Islands are numerous and varied, but have never yet been systematically described; and the authors urge upon the Irish Academy the desirability of its undertaking a detailed survey of them.

No opinion is expressed as to what race or races the Aranites belong, but it is argued that they cannot be Firbolgs, if the latter are correctly described as "small, dark-haired, and swarthy."

A short bibliography is given at the end of the paper, and a few photographs, taken by Prof. Haddon, give a general idea of the appearance of the people.

ELECTRICAL SANITATION.

A PRACTICAL application of electricity to sanitation has recently been made. Two systems have been tested upon a very considerable scale, in both of which the electrolytic action of the current has been utilised.

The two methods at present before the public are Mr. William Webster's, which is being carried out by the Electrical Purification Association (Limited), and that ascribed to Mr. Eugene Hermite, and worked by him in conjunction with Messrs. Paterson and Cooper.

As has occurred so frequently before, both these inventors appear to have conceived the same idea about the same time. Each of them took out three patents in the year 1887, but though each had the same object in view, and although in their early patents they seemed almost to be running on the same rather than on parallel lines, their recent practice is quite distinct.

Mr. Webster treats the sewage directly. He places parallel iron electrodes within a conduit or shoot, through which the sewage is passed, the electrodes being alternately connected with the positive and negative poles of a dynamo. The nascent ammonia thus evolved at the negative electrode produces an alkaline reaction, which effects the precipitation of the solid suspended matter, while at the positive pole nascent oxygen and chlorine are evolved, producing an acid reaction, whereby the organic impurities held in suspension or solution are readily decomposed and purified.

This system has been tested on a large scale, both at Crossness and at Salford. The amount of sludge formed is said to be smaller than in any precipitation process, and the effluent so pure as not to require further treatment by filtration. The process has been reported on in the most favourable manner, as regards the chemical tests of the effluent, and the ease and uniformity with which the results are obtained.

Mr. Hermite's system consists in the treatment of sea water or other chloride solutions by electrolysis. The water thus electrolysed in reservoirs is conducted as a disinfecting liquid by suitable pipes to places requiring disinfection, where it is stored in cisterns and used in place of ordinary water. The system has been experimentally tested at Havre, Lorient, Brest, and Nice, and has been reported upon most favourably in every case. It is now being tried at Worthing, where an installation has been set up under the auspices of the Mayor and corporation. As in the previous system, an oxygenated compound of chlorine is held to be produced, which burns up the sewage matter, and absolutely destroys all microbes.

Several questions have to be considered from a scientific and practical point of view, in connection with both these inventions, before their general application can be effected. The scientific view of the subject, after all, resolves itself into the answer to a single question: Is the process quite trustworthy to remove the maximum of organic matter from the sewage, and thoroughly sterilise it? As regards the practical point of view, the removal and utilisation of the sludge will have to be faced, in the first process referred to; whilst in the second, in which sludge is said not to be produced, a second water supply to houses, and the chemical action of this disinfecting water upon the pipes, tubes, and reservoirs through which it has to pass, will have to be very fully considered before the system can be adopted.

ON HOMOGENEOUS DIVISION OF SPACE.[1]

II.

§ 10. NOW, suppose any one pair of the tetrahedrons to be taken away from their positions in the primitive parallelepiped, and, by purely translational motion, to be brought into position with their edges of length QD coincident, and the same to be done for each of the other two pairs. The sum of the six angles at the coincident edges being two right angles, the plane faces at the common edge will fit together, and the condition of parallelism in the motion of each pair fixes the order in which the three pairs come together in the new position, and shows us that in this position the three pairs form a parallelepiped essentially different from the primitive parallelepiped, provided that, for simplicity in our present considerations, we suppose each tetrahedron to be wholly scalene, that is to say, the seven lengths found amongst the edges to be all unequal. Next shift the tetrahedrons to bring the edges QE into coincidence, and next again to bring the edges QF into coincidence. Thus, including the primitive parallelepiped, we can make four different parallelepipeds in each of which six of the tetrahedrons have a common edge.

§ 11. Now take the two pairs of tetrahedrons having edges of length equal to QA, and put them together with these edges coincident. Thus we have a scalene octahedron. The remaining pair of tetrahedrons placed on a pair of its parallel faces complete a parallelepiped. Similarly two other parallelepipeds may be made by putting together the pairs that have edges of lengths equal to QB and QC respectively with those edges coincident, and finishing in each case with the remaining pair of tetrahedrons. The three parallelepipeds thus found are essentially different from one another, and from the four of § 10; and thus we have the seven parallelepipeds fulfilling the statement of § 9. Each of the seven parallelepipeds corresponds to one and the same homogeneous distribution of points.

§ 12. Going back to § 4, we see that, by the rule there given, we find four different ways of passing to the tetrakaidekahedron from any one chosen parallelepiped of a homogeneous assemblage. The four different cellular systems thus found involve four different sets of seven pairs of neighbours for each point. In each of these there are four pairs of neighbours in rows parallel to the three quartets of edges of the parallelepiped and to the chosen body-diagonal; and the other three pairs of neighbours are in three rows parallel to the face-diagonals which meet in the chosen body-diagonal. The second (§ 11) of the two modes of putting together tetrahedrons to form a parallelepiped which we have been considering suggests a second mode of dividing our primitive parallelepiped, in which we should first truncate two opposite corners and then divide the octahedron which is left, by two planes through one or other of its three diagonals. The six tetrahedrons obtained by any one of the twelve ways of effecting this second mode of division give, by their twenty-four corners, the twenty-four corners of a space-filling tetrakaidekahedronal cell, by which our fundamental problem is solved. But every solution thus obtainable is clearly obtainable by the simpler rule of § 4, commencing with some one of the infinite number of primitive parallelepipeds which we may take as representative of any homogeneous distribution of points.

§ 13. The communication is illustrated by a model showing the six tetrahedrons derived by the rule 4 from a symmetrical kind of primitive parallelepiped, being a rhombohedron of which the axial-diagonal is equal in length to each of the edges. The homogeneous distribution of points corresponding to this form of parallelepiped is the well-known one in which every point is surrounded by eight others at the corners of a cube of which it is the centre; or, if we like to look at it so, two simple cubical distributions of single points, each point of one distribution being at the centre of a cube of points of the other. To understand the tactics of the single homogeneous assemblage constituted by these two cubic assemblages, let P be a point of one of the cubic assemblages, and Q any one of its four nearest neighbours of the other assemblage. Q is at the centre of a cube of which P is at one corner. Let PD, PE, PF be three conterminous edges of this cube so that A, B, C are points of the first assemblage nearest to P. Again Q is a corner of a cube of which P is the centre; and if QA, QB, QC are three conterminous edges of this cube, D, E, F are points of the second assemblage nearest to Q. The rhombohedron of which PQ is body-diagonal and PA, PB, PC the edges conterminous in P, and QD, QE, QF the edges conterminous in Q, is our present rhombohedron. The diagram of § 9 (Fig. 7), imagined to be altered to proper proportions for the present case, may be looked to for illustration. Its three face-diagonals through P, being PD, PE, PF, are perpendicular to one another. So also are QA, QB, QC, its three face-diagonals through Q. The body-diagonal of the cube PQ, being half the body diagonal of the cube whose edges are PD, PE, PF, is equal to $PD \times \frac{1}{2}\sqrt{3}$: and PA, PB, PC are also each of them equal to this, because A, B, C are centres of other equal cubes, having P for a common corner.

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[1] A paper read before the Royal Society on January 18, by Lord Kelvin, P.R.S. (Continued from p. 448.)

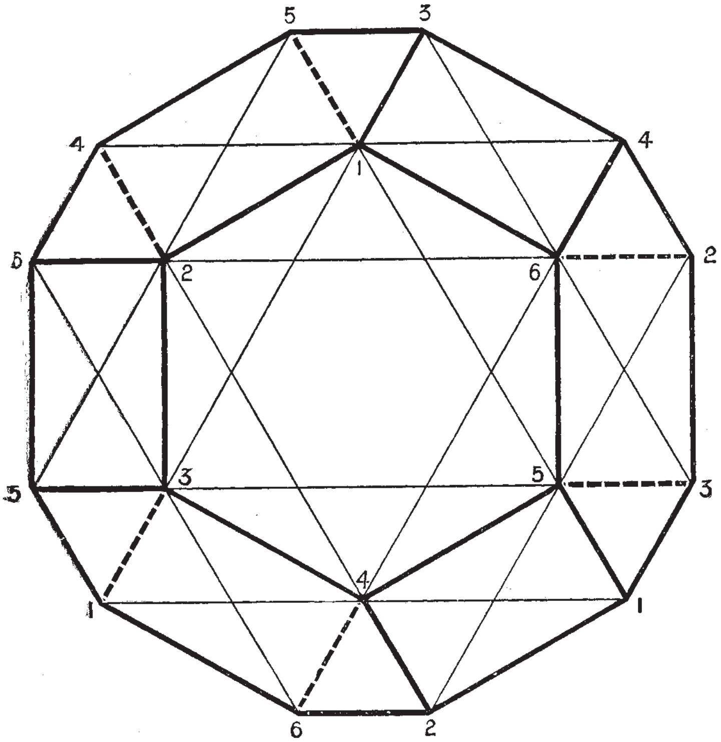

FIG. 8.

§ 14. The tetrahedrons used in the model are those into which the parallelepiped is cut by three planes through the axial diagonal, which in this case cut one another at angles of 60°. We wish to be able to shift the tetrahedrons into positions corresponding to those of the triangles in Fig. 1, which we could not do if they were cut out of the solid. I, therefore, make a mere skeleton of each tetrahedon, consisting of a piece of wire bent at two points, one-third of its length from its ends, at angles of $70\frac{1}{2}°$, being $\sin^{-1}\frac{1}{3}\sqrt{3}$, in planes inclined at 60° to one another. The six skeletons thus made are equal and similar, three homochirals and the other three also homochirals, their enantiomorphs. In their places in the primitive parallelepiped they have their middle lines coincident in its axial diagonal PQ, and their other 6 × 2 arms coincident in three pairs in its six edges through P and Q. Looking at Fig. 7 we see, for example, three of the edges CP, PQ, QE, of one of the tetrahedrons thus constituted; and DQ, QP, PB, three edges of its enantiomorph. In the model they are put together with their middle lines at equal distances around the axial diagonal and their arms symmetrically arranged round it. Wherever two lines cross they are tied, not very tightly, together by thin cord many times round, and thus we can slip them along so as to bring the six middle lines either very close together, nearly as they would be in the primitive parallelepiped, or farther and farther out from one another so as to give, by the four corners of the tetrahedrons, the twenty-four corners of all possible configurations of the plane-faced space-filling tetrakaidekahedron.

§ 15. The six skeletons being symmetrically arranged around an axial line we see that each arm is cut by lines of other skeletons in three points. For an important configuration, let the skeletons be separated out from the axial line just so far that each arm is divided into four equal parts, by those three intersectional points. The tetrakaidekahedron of which the twenty-four corners are the corners of the tetrahedrons thus placed may conveniently be called the orthic tetrakaidekahedron. It has six equal square faces and eight equal equiangular and equilateral hexagonal faces. It was described in § 12 of my paper on "The Division of Space with Minimum Partitional Area" (*Philosophical Magazine* 1887, second half year, and *Acta Mathematica*, vol. xi. pp. 121-124), under the name of "plane-faced isotropic tetrakaidekahedron"; but I now prefer to call it orthic, because, for each of its seven pairs of parallel faces, lines forming corresponding points in the two faces are perpendicular to the faces, and the planes of its three pairs of square faces are perpendicular to one another. Fig. 8 represents an orthogonal projection on a plane parallel to one of the four pairs of hexagonal faces. The heavy lines are edges of the tetrakaidekahedron. The light lines are edges of the tetrahedrons of § 13, or parts of those edges not coincident in projection with the edges of the tetrekaidekahedron. The figures 1, 1, 1; 2, 2, 2; . . . ; 6, 6, 6 show corners belonging respectively to the six tetrahedrons, two of the four corners of each being projected on one point in the diagram. Fig. 9 shows, on the same scale of magnitude with corresponding distinction between heavy and light lines, the orthogonal projection on a plane parallel to a pair of square faces.

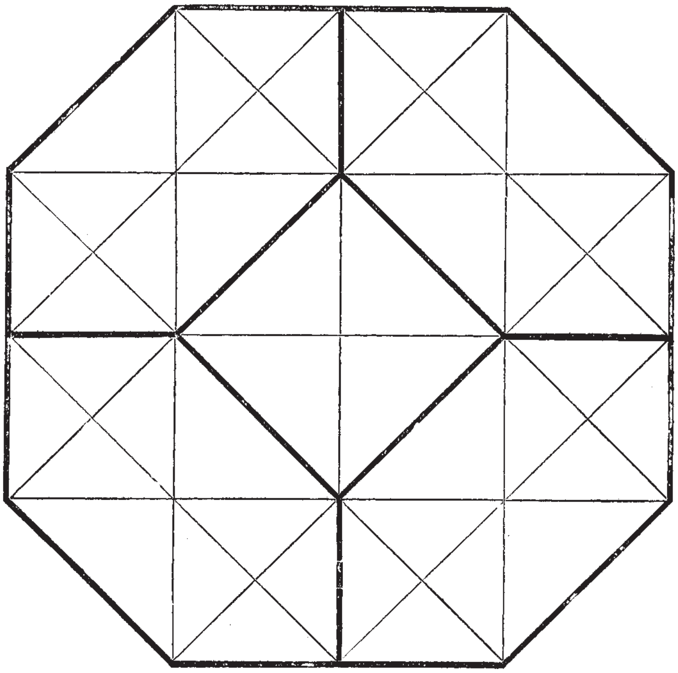

FIG. 9.

§ 16. If the rule of § 15 with reference to the division of each arm of a skeleton tetrahedron into four equal parts by points in which it is cut by other lines of skeletons is fulfilled with all details of §§ 14 and 15 applied to any oblique parallelepiped, we find a tetrakaidekahedron which we may call orthoid, because it is an orthic tetrakaidekahedron, altered by homogeneous strain. Prof. Crum Brown has kindly made for me the beautiful model of an orthoidal tetrakaidekahedron thus defined which is placed before the Royal Society as an illustration of the present communication.

Fig. 10 is a stereoscopic picture of an orthic tetrakaidekahedron, made by soldering together thirty-six pieces of wire, each 4 in. long, with three ends of wire at each of twenty-four corners.

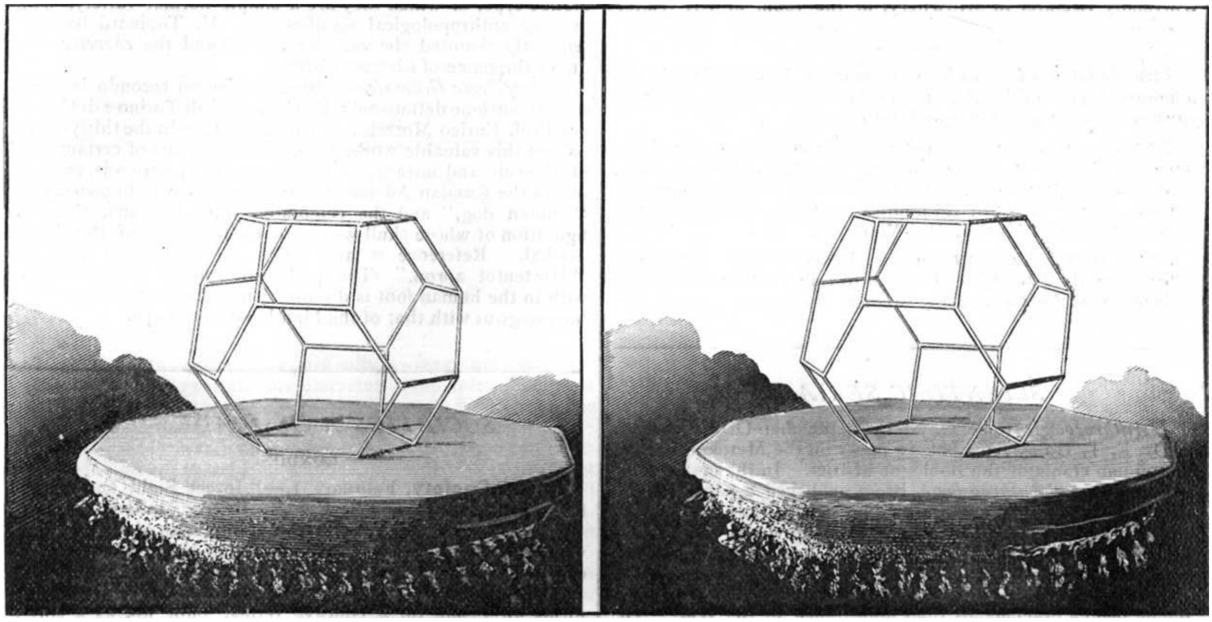

FIG. 10.

§ 17. I cannot in the present communication enter upon the most general possible plane-faced partitional tetrakaidekahedron or show its relation to orthic and orthoidal tetrakaidekahedrons. I may merely say that the analogy in the homogeneous division of a plane is this:—an equilateral and equiangular hexagon (orthic); any other hexagon of three pairs of equal and parallel sides whose paracentric diagonals trisect one another (orthoidal). The angles of an orthoidal hexagon, other than equilateral, are not 120°. The angles of the left-hand hexagon Fig. 1 (§ 7) are 120°, and its paracentric diagonals do not trisect one another, as the diagram clearly shows.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Cambridge University Natural Science Club celebrated its 500th meeting by a conversazione in the University Physiological Laboratory on March 12. This club was an early outcome of the development of natural science in the University, being founded on March 10, 1872. Its members are drawn from the senior science students in the University. Among the original members (nine in number) may be mentioned Dr. H. Newell-Martin, Prof. Liversidge (now at Sydney), and the late Dr. P. H. Carpenter. At one of the earliest meetings the late Prof. F. M. Balfour was elected. Two years later saw Prof. S. H. Vines and the late Prof. Milnes Marshall added to the list of members. It is interesting to note that the first volume of "Studies from the Physiological Laboratory, Cambridge," published in 1873, contained contributions from four of the original members of the club. At that time this laboratory, which is now large enough to accommodate easily a large conversazione, consisted (in the words of Prof. M. Foster) of "two rooms in which my lectures are given, the practical teaching of my class conducted, and the physiological work carried on." So that the interval between the first and 500th meetings of the Science Club represents an important epoch in the history of the Cambridge Science School, and gives to the conversazione a special interest.

Although the aggregate number of members in the club during these twenty-two years only slightly exceeds 150, it may be observed that this number includes sixteen Fellows of the Royal Society and eighteen Professors holding Chairs in British and colonial universities and colleges. In addition to these a considerable number of university and college lecturers have belonged to its membership during their student days, so that the club may fairly claim to have borne its part in the scientific teaching of the day.

The conversazione of the club, held on Monday, was attended by about 600 persons, including a considerable number of eminent men of science, both British and Continental. The Physiological Laboratory was gaily decorated for the occasion, and many exhibits in the different branches were on view. Prof. Ramon y Cajal kindly showed specimens illustrating the histology of the central nervous system. The Botanical Department included exhibits by Mr. F. Darwin, F.R.S., and Mr. W. Gardiner, F.R.S.; demonstrations in electricity were given by Prof. J. J. Thomson, F.R.S. One large room was devoted to the exhibition of scientific instruments and machines in motion, among which we might mention engineering apparatus, shown by Prof. Ewing, and Callendar's new pyrometer, by the Cambridge Scientific Instrument Company. Chemistry, geology, physiology, and pathology were also well represented. The Anatomical Museum was occupied by the Ethnological Department, under the direction of Prof. MacAlister, Mr. Hickson, Prof. A. C. Haddon, and Baron von Hügel. A great feature of the evening was in the lecture theatre, where Dr. A. R. Wallace, F.R.S., delivered a polemic on "Geographical Distribution," while Prof. C. V. Boys, F.R.S., lectured on "The Photography of Flying Bullets," and Mr. Martin Conway on his recent travels in high altitudes among the Himalayas.

Dr. Donald MacAlister, Fellow and Tutor of St. John's College, has been appointed Linacre Reader of Physic, in succession to Dr. Bradbury, the new Downing Professor of Medicine. Dr. MacAlister was Senior Wrangler and First Smith's Prizeman in 1877.

Prof. Foster has been appointed a delegate to represent the University at the eleventh International Medical Congress to be held this month in Rome.

Dr. Anningson, Medical Officer of Health for Cambridge,